M&S Credibility Factors

Jack Sheehan

25 February 2002

Factors Pressing for more M&S in Operational Test and Evaluation

- Substantial increase in operational mission complexity and required integration
- External encroachment on existing ranges in the face of significant increases in geographic stand-off between new and emerging operational systems and targets
- Desire to simultaneously reduce the time-to-field new systems and reduce life-cycle systems costs
- Desire to simultaneously increase T&E realism while reducing M&S costs, and
- Technology push from the modeling and simulation community

To Make a Difference, M&S needs to be:

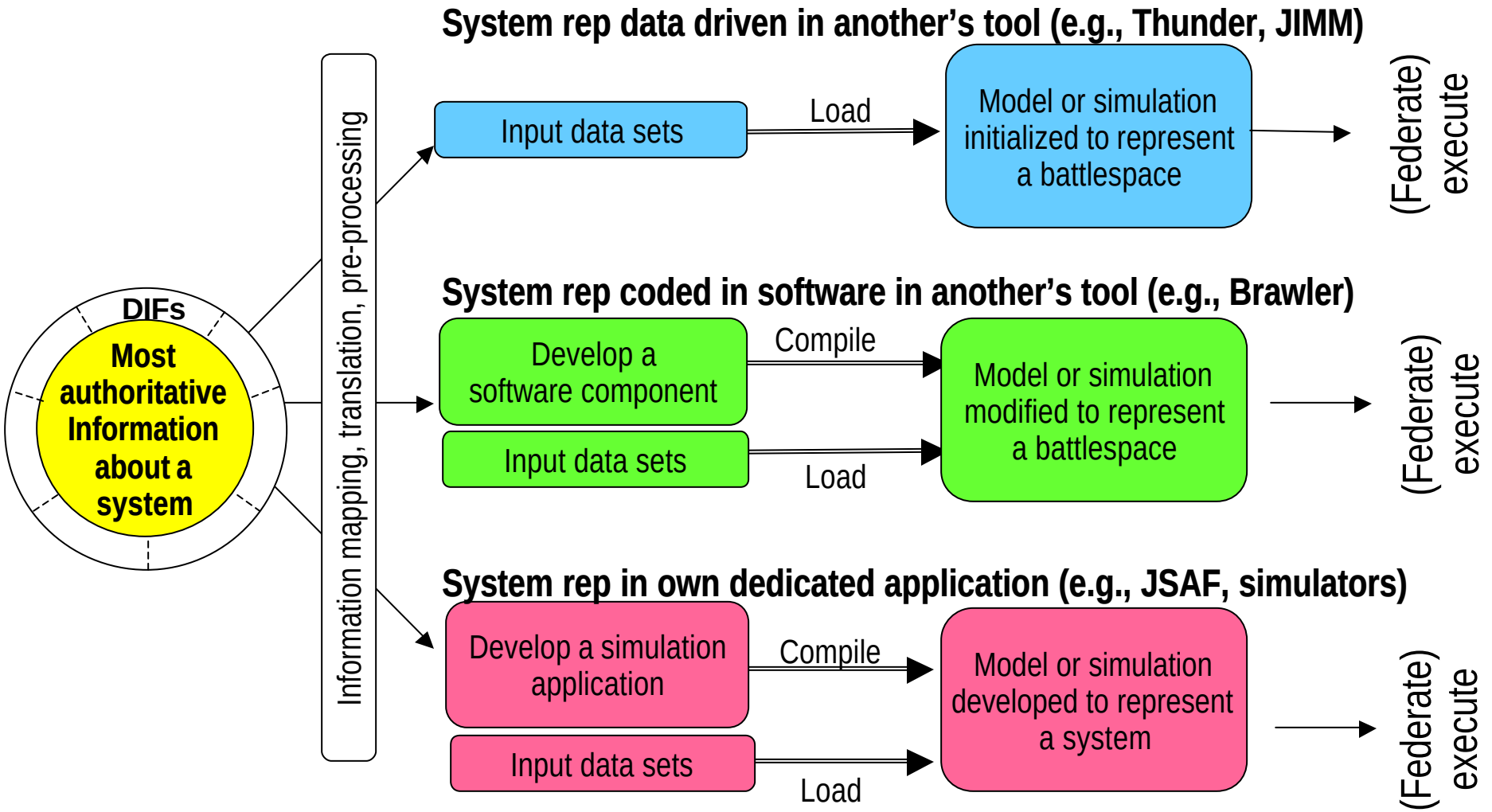
- **Credible** (which of the possible test scenarios provides the most important information, do the actual test conditions achieved provide reliable operationally-realistic KPP estimates, for the observed performance what is the operational effectiveness, survivability, and suitability of the forces and materiel under evaluation
- **Timely** (need M&S setup times that are commensurate with execution times for pre-test predictions, test execution, and post-test evaluation)
- **Affordable** (existing development, setup, verification, validation are complex, labor-intensive activities)

The Key to Success is…

- Rapid, relentless, repeatable closed-loop iteration among the domain experts, M&S integrators, and end-use stakeholders.

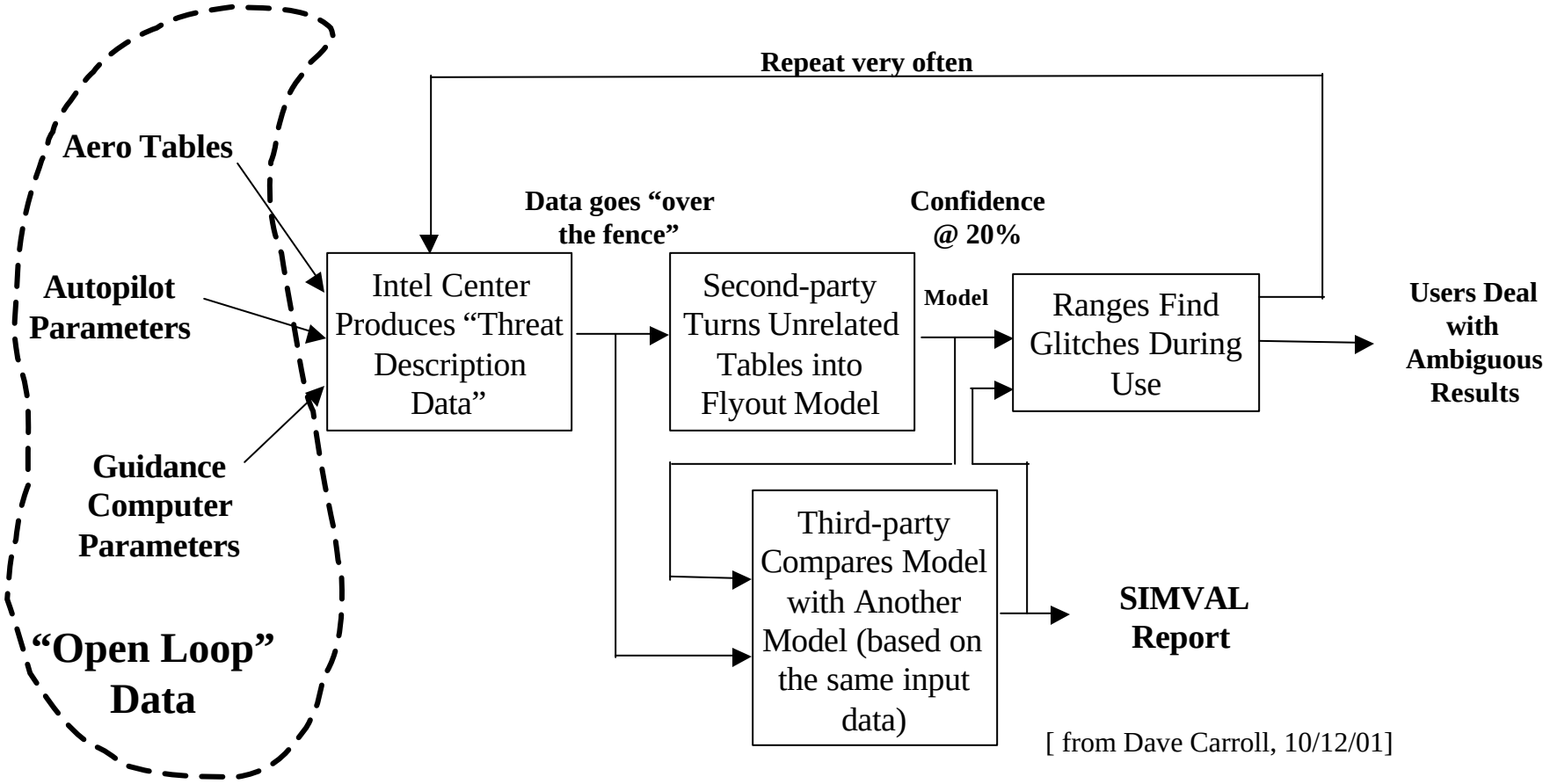
- At present, these iterations are really once-through-activities with months/years time steps when relentless iterations in hours/days is needed.

Three Paths to System Representations



[from Jim Hollenbach, JSF 1/15/02]

Old Process

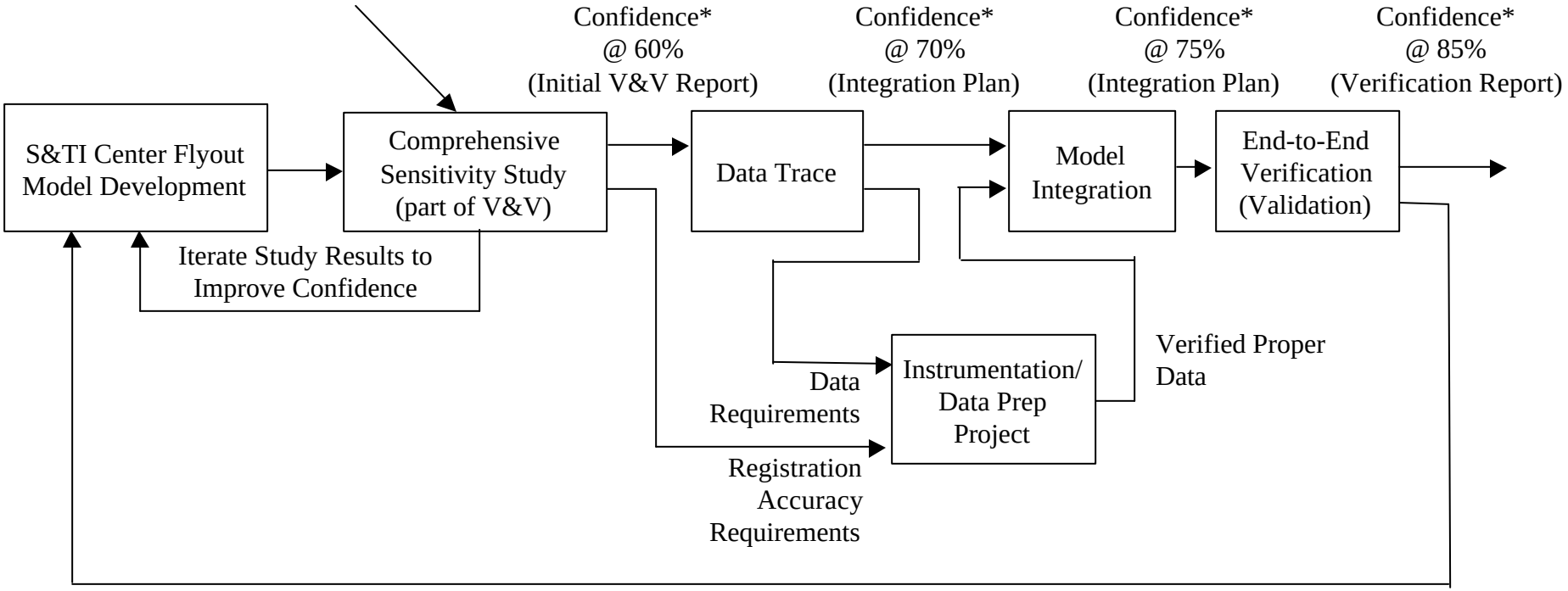


[from Dave Carroll, 10/12/01]

Fix one problem, disclose another. This was bound to occur until the Intel Center took on responsibility for providing dynamic, closed-loop models instead of parameters as the threat description data.

Improved Process

MSEA Incorporates Sensitivity Methodology and Resultant Data in V&V Report



Closing the loop with flight test results and questions from T&E and Training
Continuous V&V

[from Dave Carroll, 10/12/01]

* Confidence that integrated simulation delivers credible representation of threat capability

Enabling the 3 R’s

- Policy and Business Model Changes
- Executable Mission Content
- Framework and Interfaces
- Common Processes
- Long Lead Investment

Bottom Line Up Front

- What Needs to Change:
  - Culture (it's all about funding)
  - Management (bona fide Joint mission offices)
  - Technology (it's about rapid composability not individual capability)
- How to Change It:
  - Joint Pays First (control of the funding drives everything else)
    - Focus is on Mission-centric transformation of task-organized Joint and Combined forces (not Force-centric defense of traditional Service-centric roles and missions
    - Output is competitively awarded OSD funding (based on genuine Joint/Combined content) over-and-above stove-piped RDT&E, APB, and O&M funding lines)
  - Rapid Concept Formulation (it's about the mission not the platform):
    - Focus is on rapid, credible human interaction
    - Output is operational concepts formulated as mission-based requirements
  - Joint Experimentation (it's about the playbook not the player)
    - Focus is on realistic, physical interaction (man, machine, environment)
    - Output is systems of systems concepts formulated as capability-based specifications
  - Joint Systems-of-Systems Acquisition (it's about lifecycle cost for mission success against emerging and alternative threats)
    - Focus is on credible mission-cost-benefit in system engineering trade-offs
    - Output is rapidly composable warfighting capability.

Joint Pays First

Current Condition:

- Force-centric defense of traditional Service-specific roles and missions

Needs to Change to:

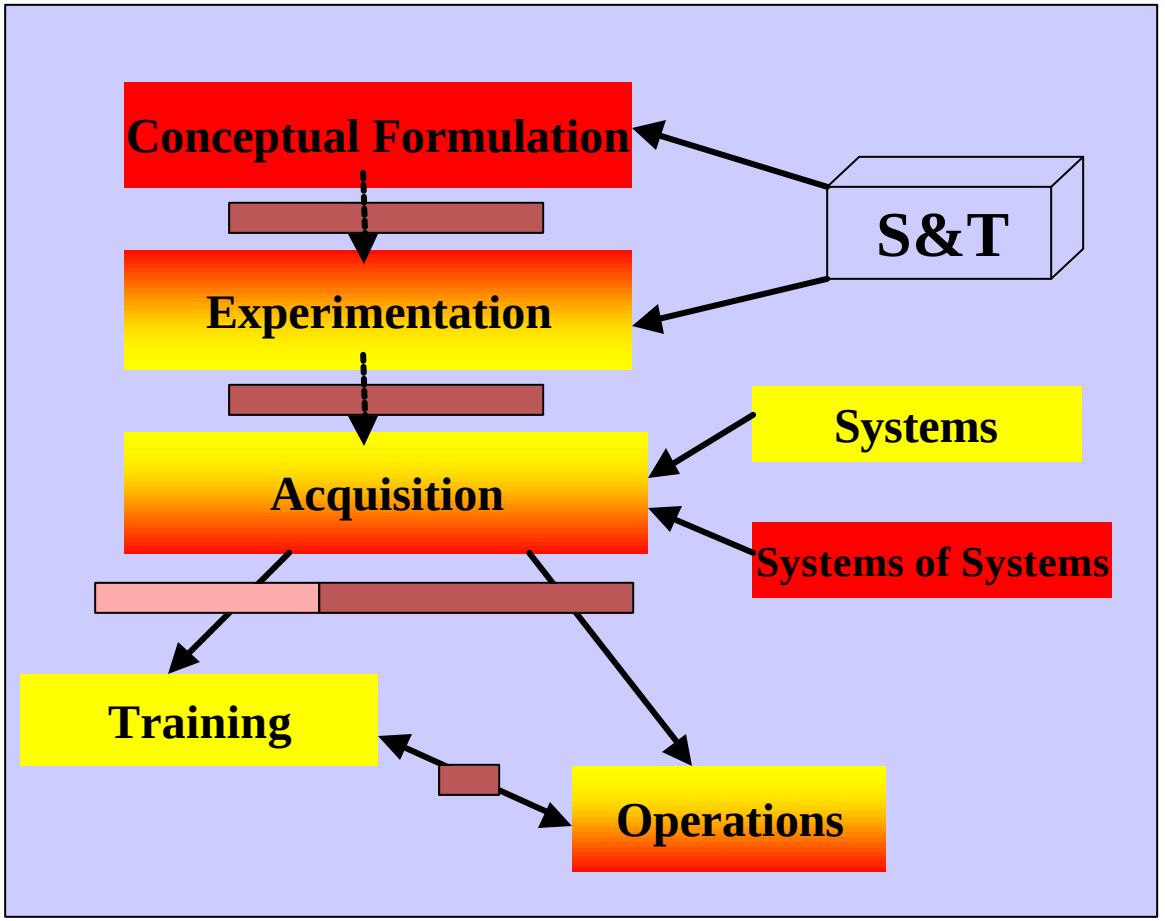
- Mission-centric transformation of task-organized Joint and Combined forces

Enable Change by:

- Forming genuine Joint Mission Area program offices
- Competitively award OSD plus-up funding (based on bona fide Joint/Combined mission content) over-and-above stove-piped S&T, APB, and O&M funding lines
- Require Joint Mission Area certification of models and simulations, mission requirements, capability specifications, materiel and personnel readiness

Output is:

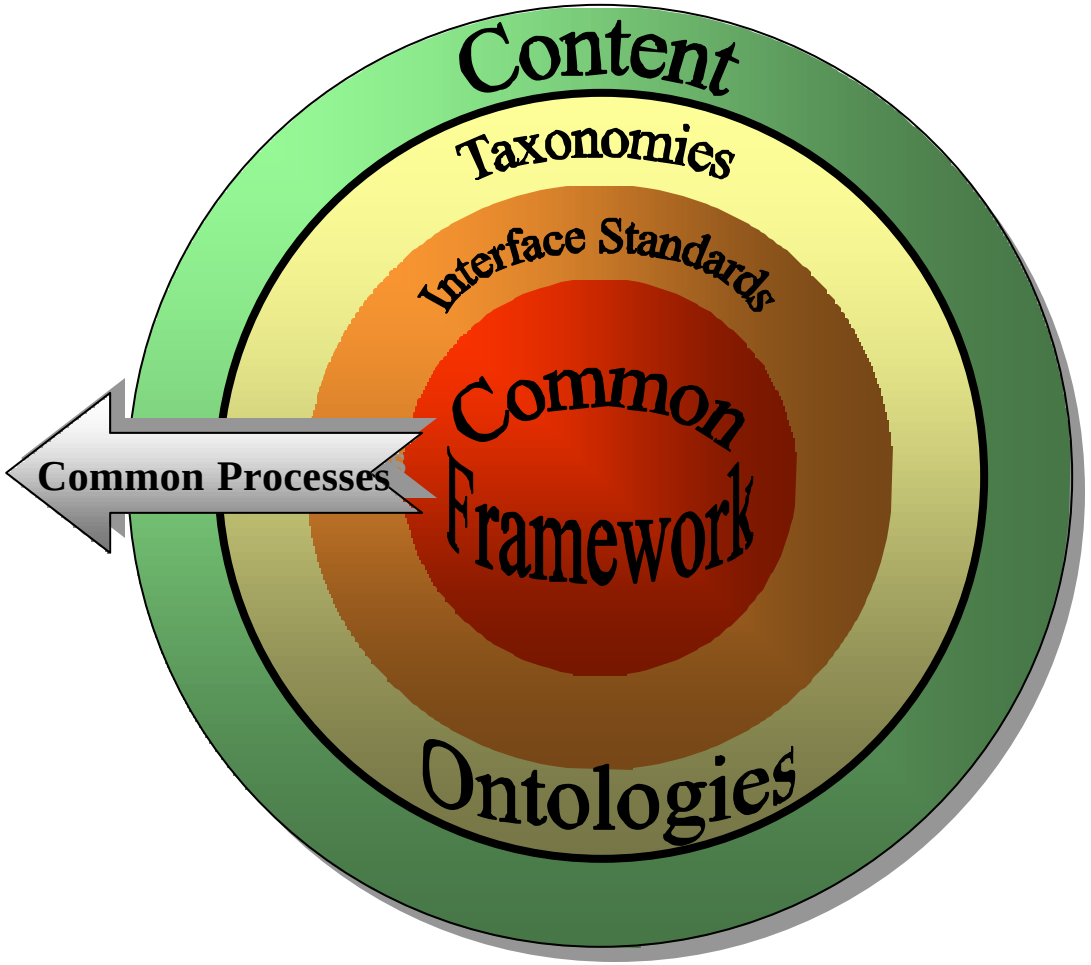
- Defense budget that funds by Joint Mission Area rather than by Materiel Force Structure



Communities are separate, no incentive to work across boundaries

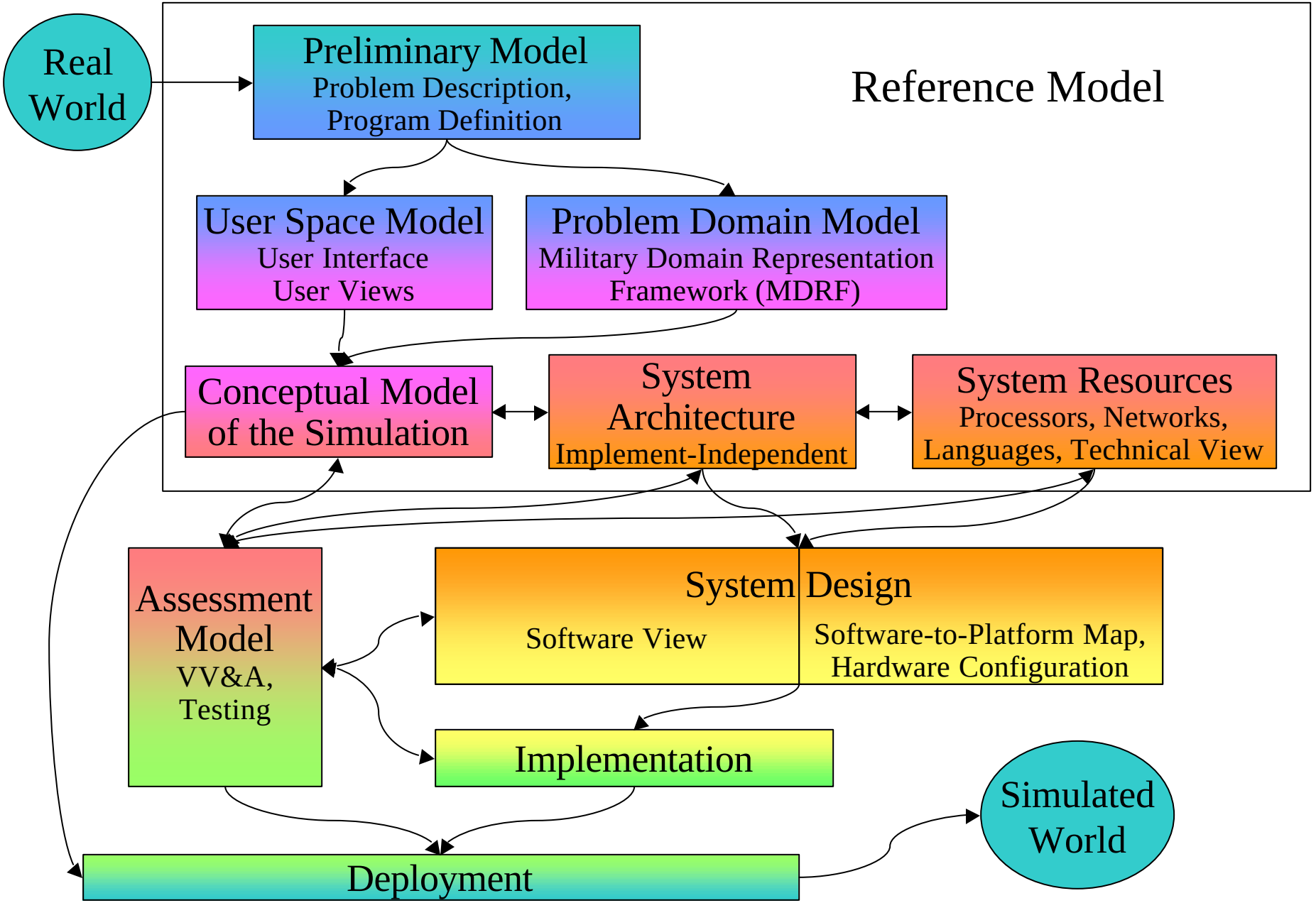
Fund from the Center based on bona fide Joint/Combined Mission Content

Collaborative Environment



- Common Framework(s)
  - Software environment in which content works together to make a simulation
- Interface Standards
  - Defines the inputs and outputs to content
- Standard Taxonomies / Ontologies
  - Taxonomies are hierarchically organized concepts
  - Ontologies provide explicit and precise descriptions of concepts and relations that exist in a particular domain
- Common Processes
  - For *instancing* content into a framework
  - For verifying, validating, and accrediting baseline content and *instanced* content

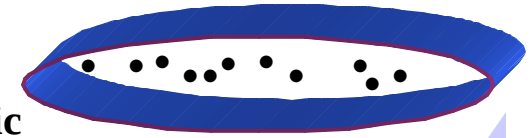
[from Steve Swenson, NUWC, 10/12/01]



Simulation Development: From Real World to Simulated World
[from Furman Haddix, ARL:UT, 9/10/01]

Representation Taxonomy for Executable Mission Content

Mission-based,
Activity-Centric

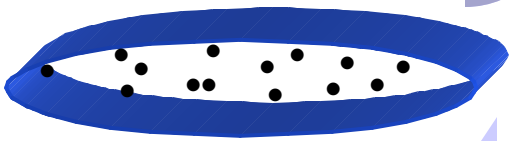


Level 4

Operational
Testing

$O_{3,4}$ Operator

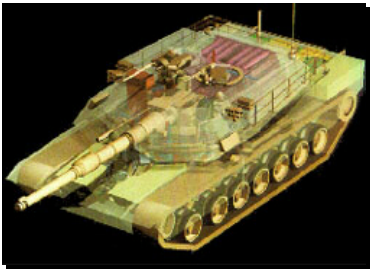
Performance



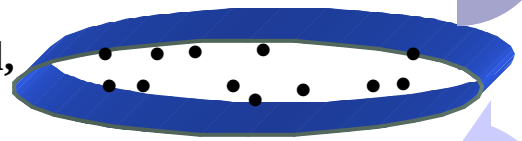
Level 3

Developmental
Testing

$O_{2,3}$ Operator



Capability-based,
Entity-centric



Level 2

Developmental
Testing

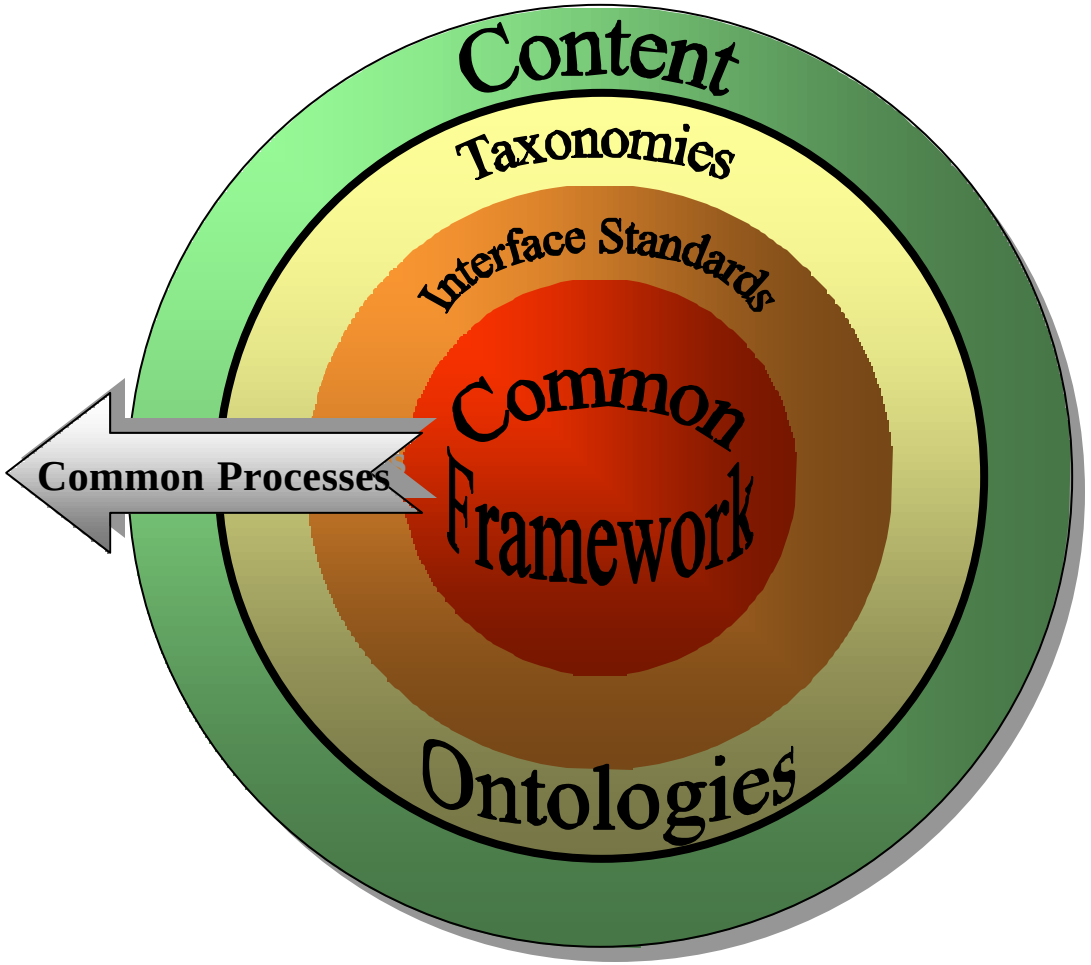
$O_{1,2}$ Operator

Interaction

Level 1

[from Paul Deitz, AMSAA, 10/4/01]

Collaborative Environment



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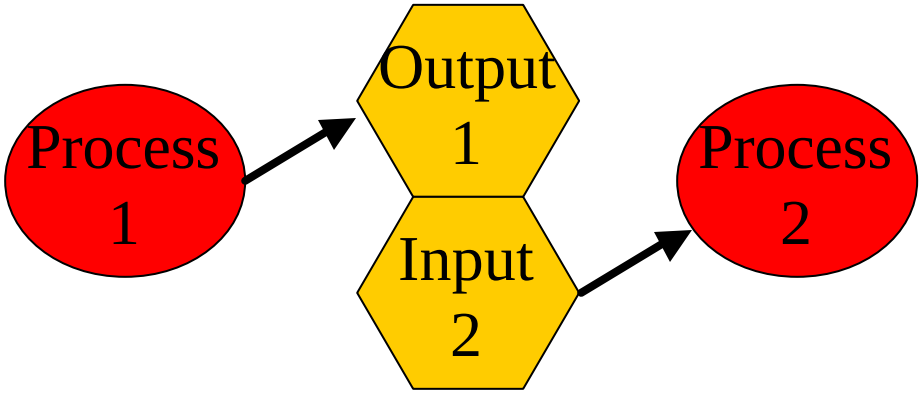
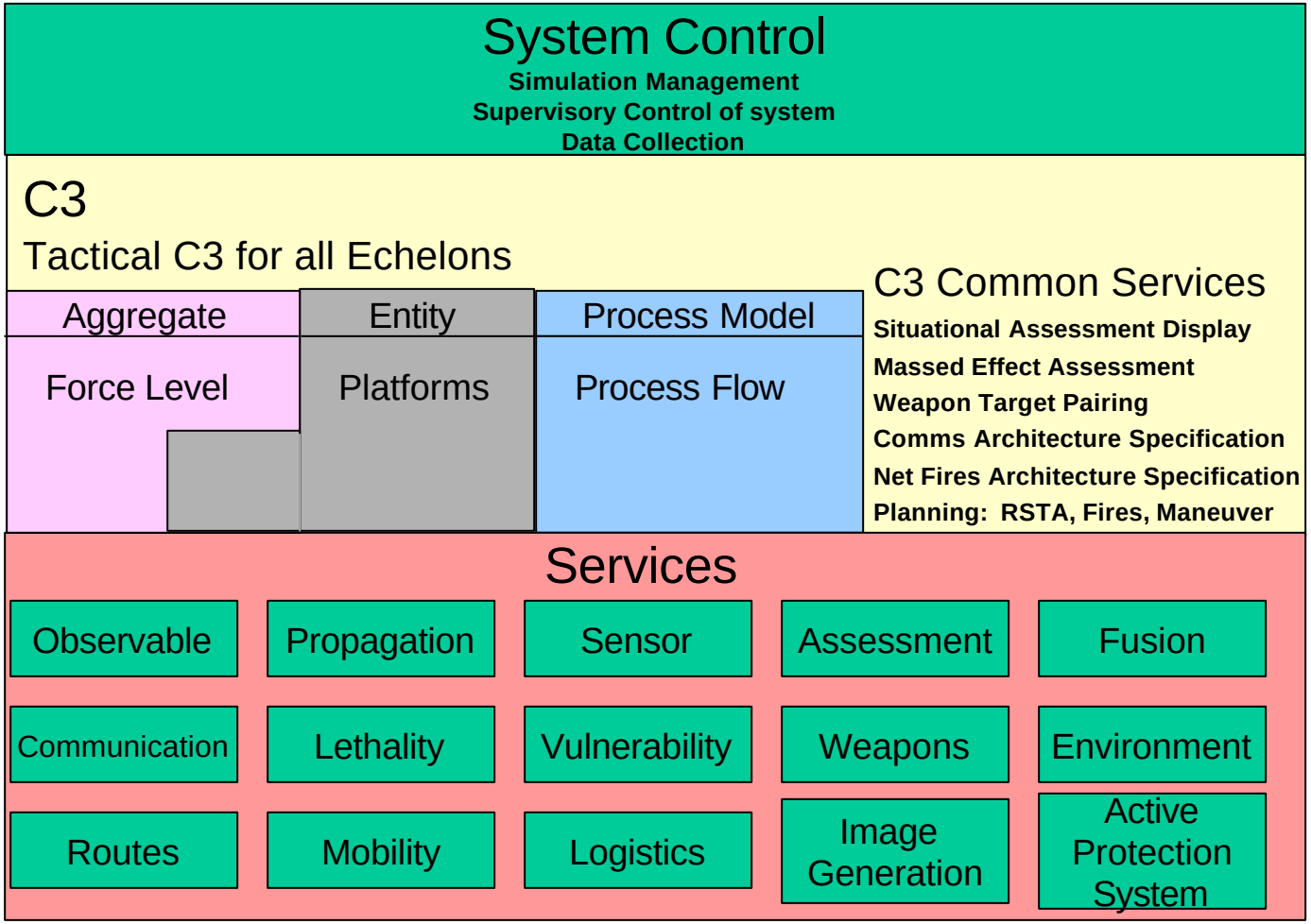
[from Steve Swenson, NUWC, 10/12/01]

HLA is a runtime architecture
for distributing model outputs
as inputs for other models

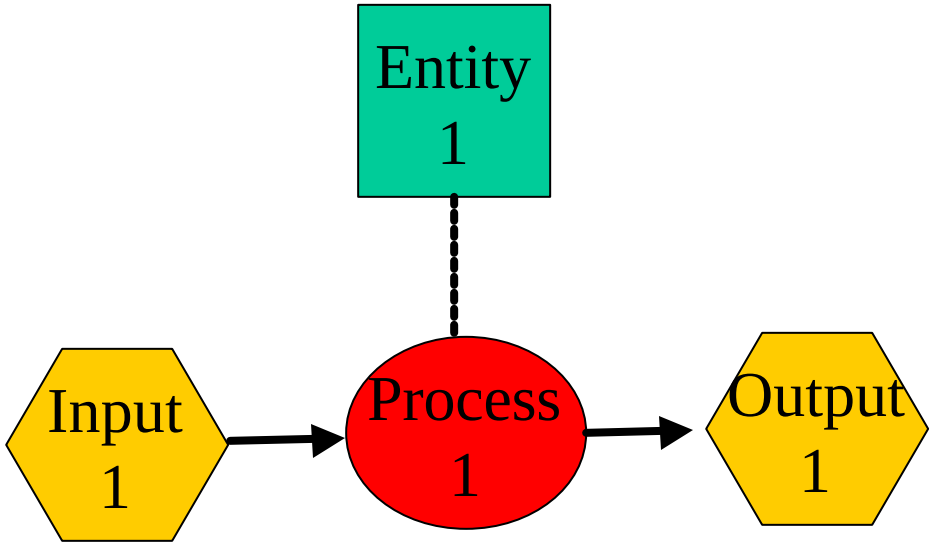


JVB Software Architecture

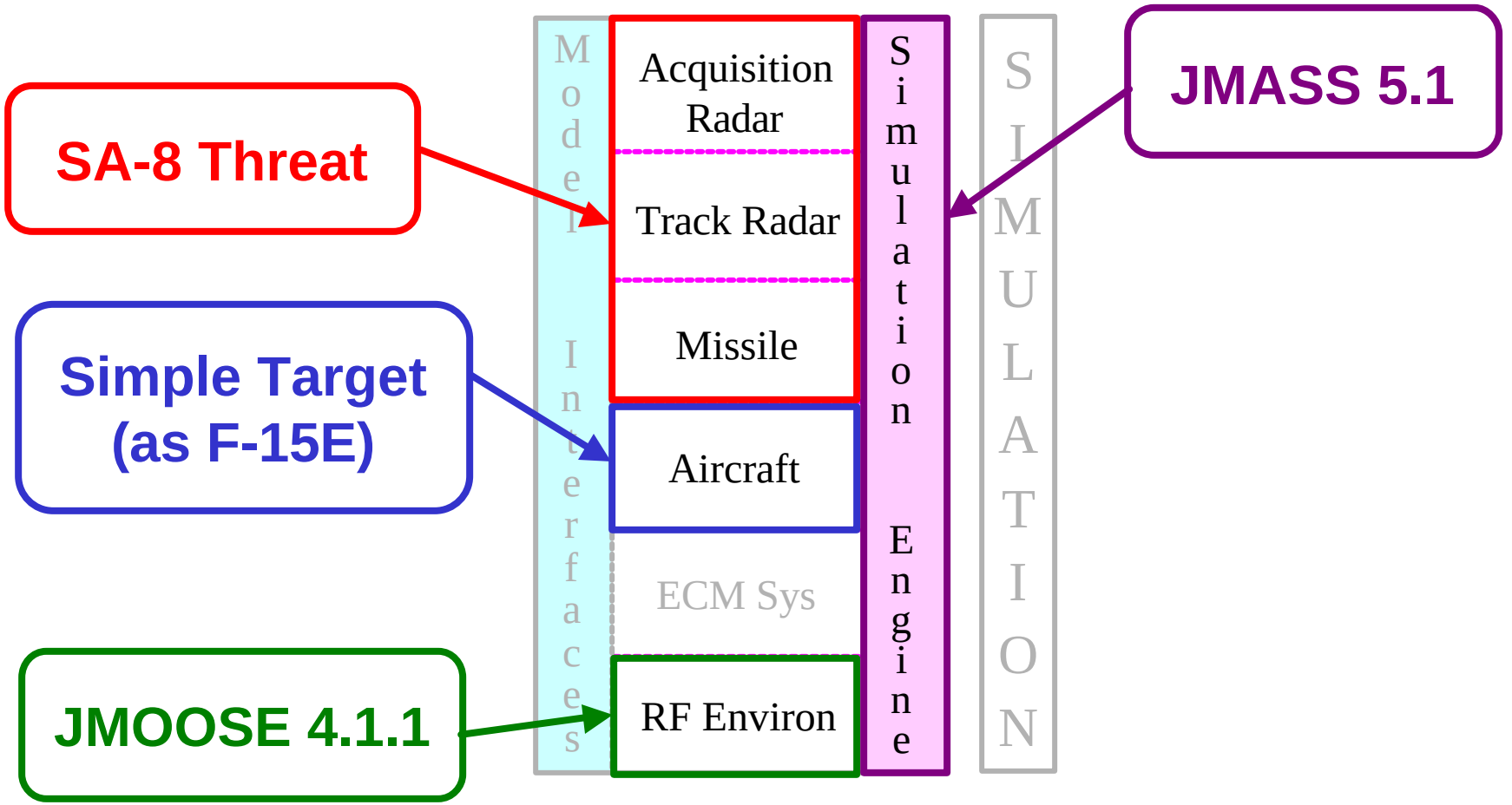


[from Richardson, JVB, 10/02/01]

JMASS is a runtime architecture for transforming inputs into outputs



View of IOC RF SAM simulation



[from Lt Col Jacobson, 10/12/01]

Both types are required for execution
-- and must be compatible

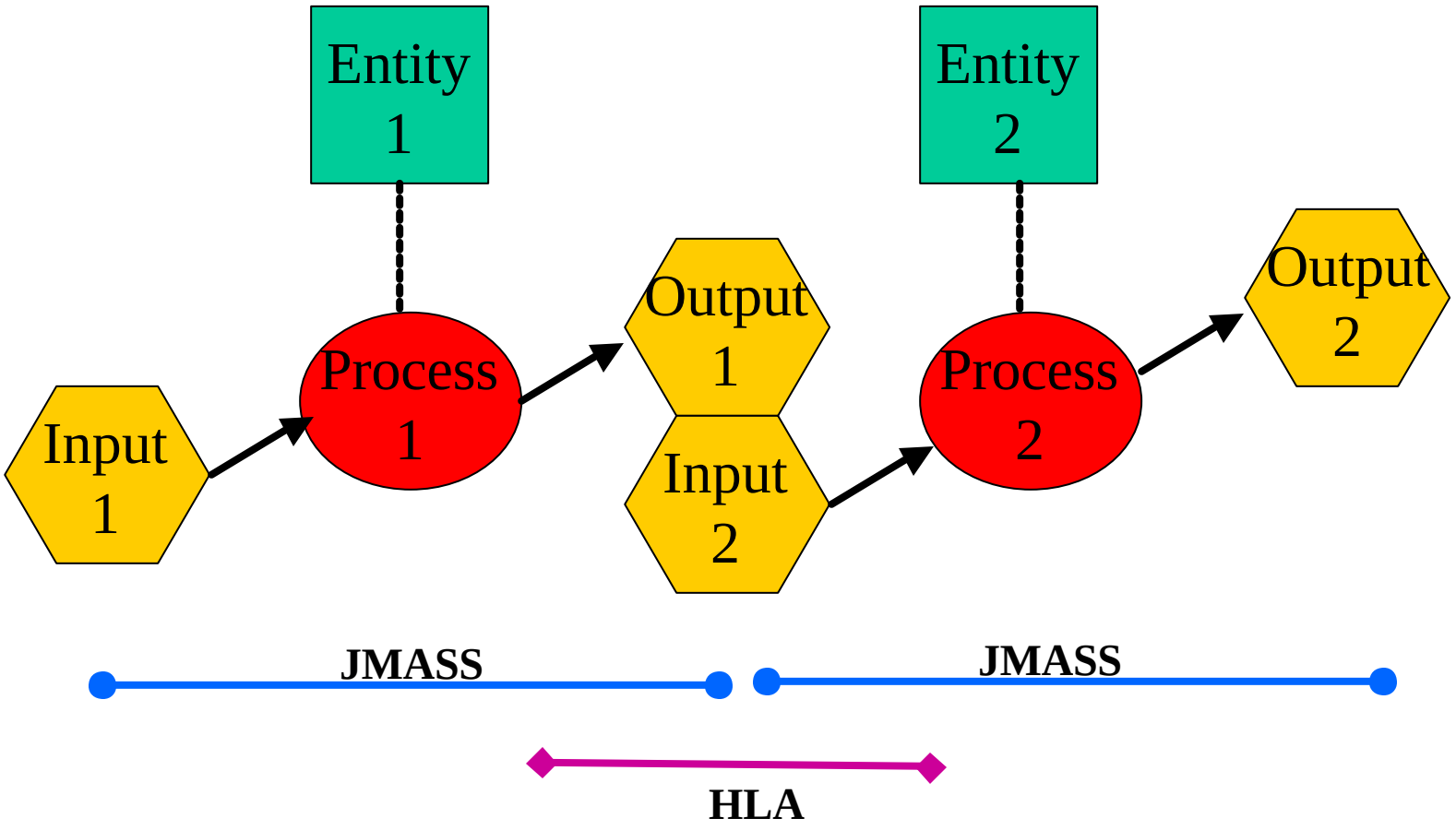


Figure 12

A model + data provisioning architecture is also required to

-- define the scenario and

-- initialize the models

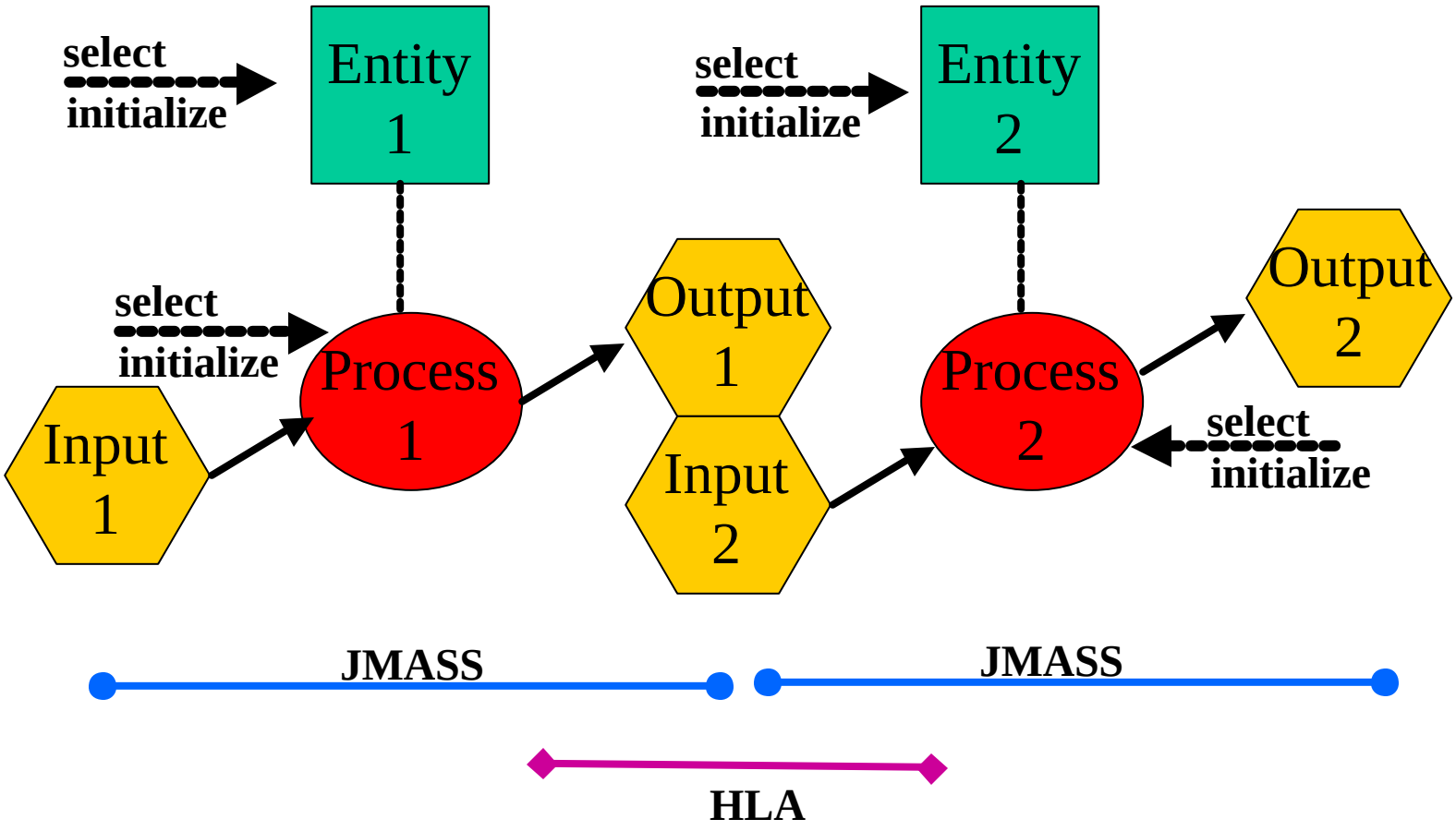
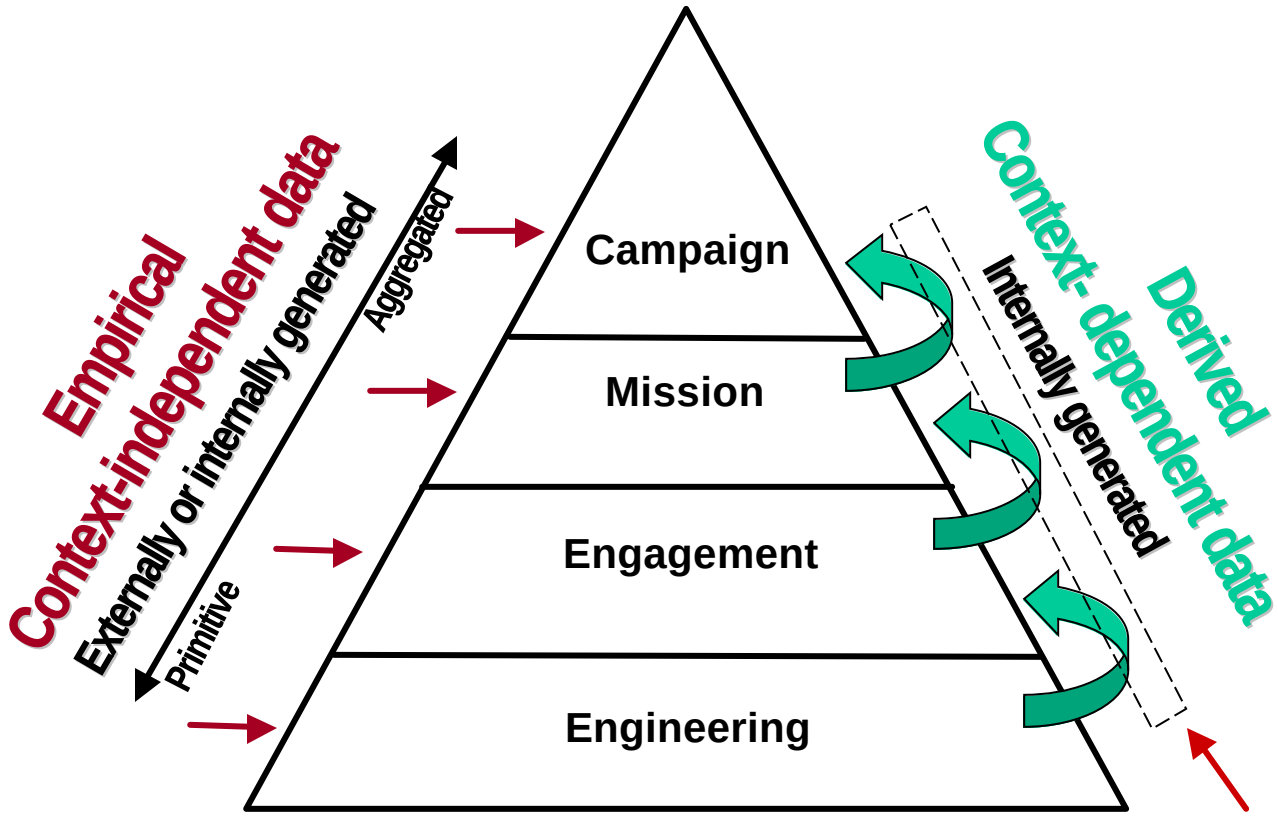


Figure 13

How Data Flows

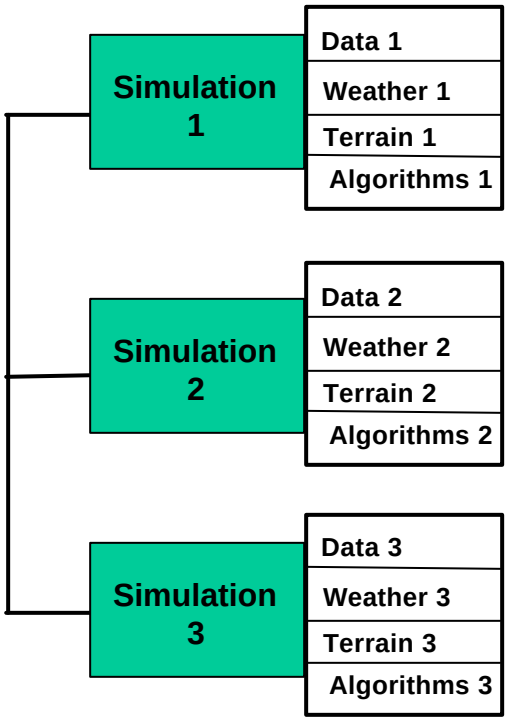


- Assumes a certain operational context
- Normally some pre-processing at each transition

[from Jim Hollenbach, JSF 1/15/02]

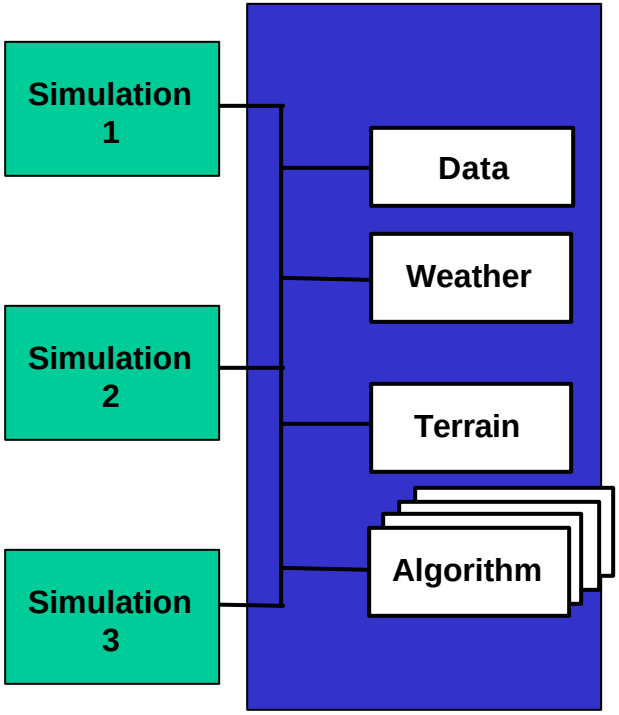
JVB Common Battlespace

Current Approach



Precoordinate to Ensure Everything is as Consistent as Possible.
Post Coordinate to Interpret Inconsistencies Between Models

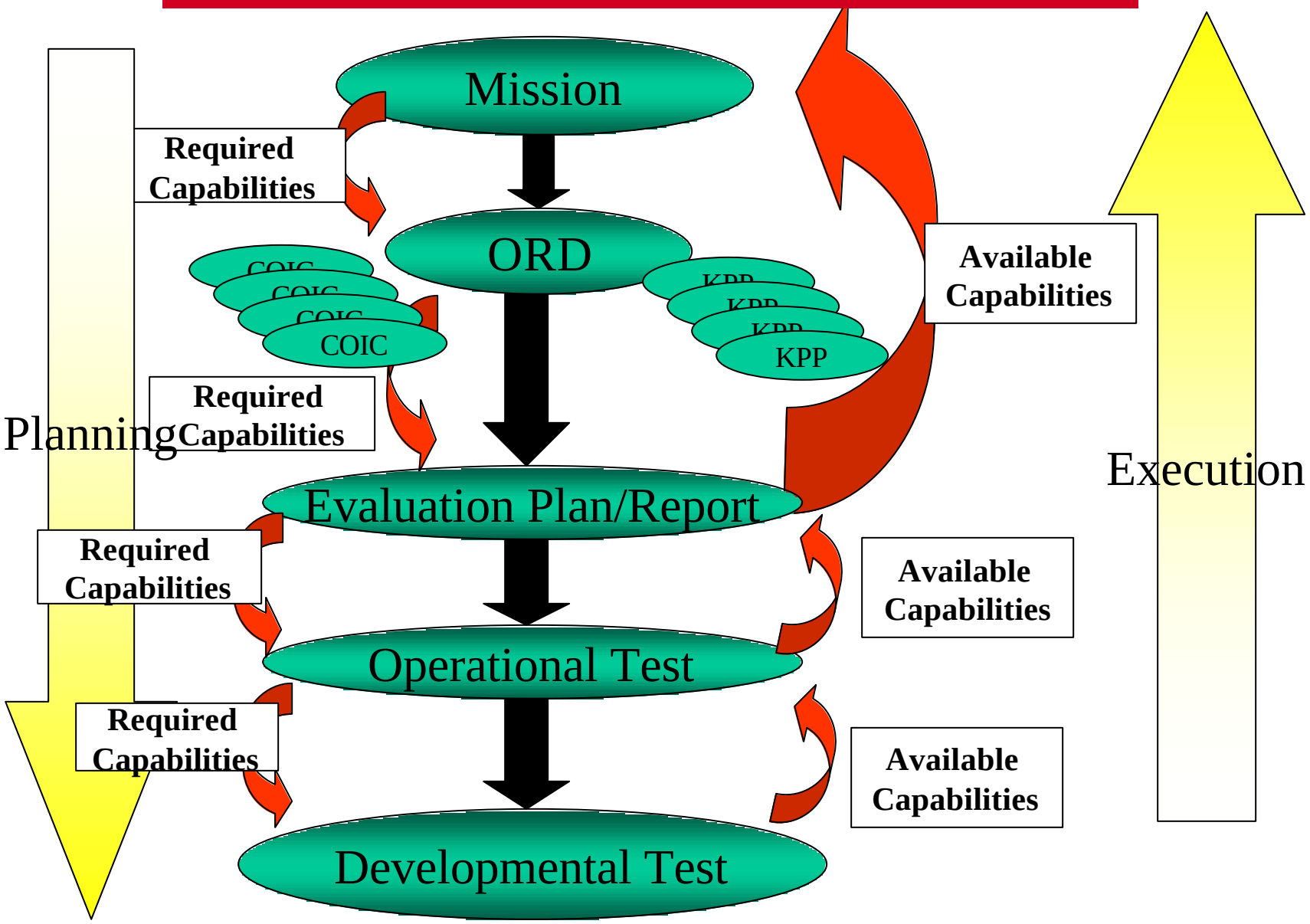
JVB Framework



All Simulations Use Same Data and Algorithms

[from Richardson, JVB, 10/02/01]

Coordinated Approach to Acquisition‡



[From William Hughes, OPTEC/AEC, 12/15/01]